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A Study of the Impact of Population Aging on the Effectiveness of Household Financial Asset Allocation

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Abstract

Based on the perspective of population aging, this paper explores the impact of aging shocks on household financial asset allocation behavior, and constructs cross-period tracking panel data based on the 2015, 2017, and 2019 China Household Finance Survey (CHFS) data to empirically investigate the mechanism by which population aging affects different dimensions of household financial asset allocation behavior. The results of the study find that (1) population aging significantly inhibits household portfolio effectiveness; and this conclusion still holds after replacing variables and robustness testing of the model. (2) The mechanism analysis illustrates that population aging affects household financial asset allocation effectiveness through wealth constraints and health risk paths. (3) Heterogeneity analysis illustrates that there is urban-rural and wealth heterogeneity in the impact of population aging on financial asset allocation. The negative impact of population aging on financial asset allocation is more pronounced in rural households and in households with low wealth levels.

Keywords: population aging, household financial asset allocation, pension finance, Sharpe ratio

1. Introduction

Population ageing is a major trend in the current demographic changes in China. The Vice-President of the China Center for International Economic Exchanges has pointed out that population is a fundamental variable for economic growth. Population aging will not only constrain the high-quality development of the economy on the supply and demand sides, but also increase the pressure on society and families to provide for the elderly. At this stage, the economic sources of Chinese elderly people mainly rely on three aspects: family, public pension and property income. Due to the impact of health risks and longevity risks, the pension system, with family support and pensions as the main pillars, will face great challenges, while the importance of property income as a support for old age is gradually increasing. (Zhou, L., 2023). On the one hand, population aging will directly reduce the effective supply of labor force by decreasing the number of children, and changing the age structure, which will increase the pressure on the old age of the society and the family. On the other hand, population ageing will indirectly affect the allocation of family financial assets by changing the demographic structure of the family, thus restricting the wealth retirement of Chinese families through the increase of property income to cope with the impact of “ageing before getting rich”. Ageing will affect the allocation of household financial assets through different channels, such as changing constraints, utility preferences and information efficiency (Ba, S., Wang, M., & Li, C. (2023) which is not conducive to the transformation of China's pension system.

Against the backdrop of the transition from savings to wealth, it is of great significance to explore how families can reasonably and effectively allocate financial assets to actively cope with ageing, and to prevent and resolve family financial risks in the silver age. Studying the impact of population aging on the allocation of family financial assets can not only provide guidance for family financial investment, but also help financial institutions more comprehensively grasp the characteristics of the family structure, so as to develop targeted financial products that are more in line with the characteristics of the elderly, and provide different families with financial services that are more suitable for them. This study aims to (1) explore how population aging affects the allocation of family financial assets; (2) explore the path of population aging affecting the effectiveness of the allocation of family monetary assets; (3) as well as explore the urban-rural heterogeneity and wealth heterogeneity in the effectiveness of population aging affecting the allocation of family monetary assets.

2. Literature Review

2.1 Population Ageing, Constraints and Household Financial Asset Allocation

Firstly, based on life-cycle theory, changes in age structure affect the constraints at the time of household decision-making. On the one hand, aging increases longevity risk. As an increase in human life expectancy leads to a longer life cycle after retirement, i.e., a longer phase of consuming savings, households will need more retirement wealth after retirement. (Bajtelsmit, V. L., & Wang, T., 2018). This may result in insufficient old-age reserves. The risk of longevity as leading to stronger individual precautionary saving incentives may have a crowding-out effect on household participation in risky financial markets. And individual retirement changes the efficiency of household asset allocation by increasing social security expenditures. (Zhou, L., Liu, H., & Li, J., 2023). On the other hand, aging increases health risks. Individual health is positively correlated with resources at their disposal, and poor health may imply insufficient disposable wealth, which reduces financial investment. (Smith, J. P., McArdle, J. J., & Willis, R. J., 2010). Poor individual health also implies more healthcare expenditures in the future leading investors to reduce the asset risk associated with financial investment. Increasing health risk with age reduces the probability of household participation in risky financial markets by changing investors' risk preferences. Based on the background risk theory, health risk makes the financial market risk that households are willing to take decrease.

2.2 Population Ageing, Risk Appetite and Household Financial Asset Allocation

Second, changes in the age structure affect residents' risk preferences and thus the household utility function. As ageing deepens, households become more risk-averse. As age increases, investors value liquidity or ease of portfolio management more than the higher returns that may be obtained from risky financial assets., an increase in the family dependency ratio means that individuals need to take more responsibility for supporting the elderly, which in turn will affect their risk attitudes. The changes associated with increasing age and risk attitudes are largely attributed to cognitive aging. As age rises, a person's cognitive ability declines, while the degree of investment experience accumulation rises. Accumulated investment experience and cognitive decline have an inverse effect on portfolio effectiveness. (Zhou, C., 2021). Therefore, changes in individual risk preferences are a result of the combined effect of accumulated investment experience and cognitive decline. At the same time, the change of residents' risk preference will be affected by factors such as gender, education level, financial literacy, which will lead to the family's financial asset allocation to show preference differences.

2.3 Population Aging, Information Efficiency and Household Financial Asset Allocation

Finally, changes in age structure affect the degree of informational efficiency of households, and increased informational efficiency reduces the cost of market participation for households, thus facilitating a better allocation of risky financial assets. The higher an individual's information acquisition capacity, the more likely he or she is to make “rational” investment decisions. Information efficiency can therefore be broken down into factors such as individual cognitive ability, financial literacy, financial knowledge, investment experience, and the digital divide. In terms of cognitive ability, aging is often accompanied by deteriorating cognitive status, and cognitive decline can negatively affect household risky financial market participation decisions through both information processing and risk perception channels. In terms of financial literacy, existing studies generally agree that financial literacy has a positive effect on households' participation decisions in risky financial markets. Financial literacy includes an individual's financial knowledge, behavior, attitude, and financial experience. human study found that subjective and objective financial literacy and financial literacy self-confidence bias increase the breadth and depth of residents' stock market participation. Regarding the digital divide, older adults are more likely to be excluded by digital information and tools. The existence of the digital divide significantly reduces access to information via the Internet for households that are not formally educated, headed by married males, unaware of ICT, and engaged in agriculture. Population aging affects household economic vulnerability (Zhang, Z., Zhao, B., & Cheng, C., 2023) by raising the digital divide, which indirectly affects household financial allocation behavior. As for financial literacy and investment experience, it is widely recognized in the academic community as having a significant positive impact on household financial market participation and household asset choice (Shimizutani, S., 2020).

2.4 Review of Literature

There are fewer studies on how ageing affects family portfolios. With regard to the diversity of family portfolios, most of the existing literature that examines the age structure and the allocation of family financial assets focuses on the level of holdings of individual financial assets, with little attention paid to the overall holdings of financial assets. With regard to the effectiveness of household portfolios, there are still fewer articles that directly study the relationship between age and the effectiveness of household portfolios, and the conclusions of related studies are inconsistent (Lu, Y., & Xie, J., 2023).

In terms of the mechanism of action, according to the existing literature, aging mainly affects the effectiveness of family asset allocation by influencing the risk appetite and information efficiency of families. In terms of risk appetite, aging affects residents' risk appetite through health status, cognitive level, financial literacy and other channels, which results in the overall tendency of households' investment decision-making to be conservative, insufficient depth and breadth of investment allocation, and inefficient allocation. In terms of information efficiency, aging can affect the information efficiency of households through two mechanisms: experience and cognition. The decline in cognitive ability of the aging group can lead to a decline in its information efficiency, yet the aging group may be more informationally efficient due to its richer investment experience. Therefore, the mechanism by which population aging affects portfolio effectiveness through informational efficiency is unclear. Existing studies mostly examine the impact of individual cognitive ability, financial literacy, financial knowledge, investment experience, and digital divide on household financial asset allocation separately, and lack a direct measurement model of informational efficiency. Although the existing literature has theoretical analysis using cognition and experience as mechanisms[8], there are fewer studies on empirical aspects. At the same time, financial literacy and digital divide can also affect the financial investment behavior of households by reducing the degree of household information efficiency.

In summary, this study divides household financial asset allocation behavior into three dimensions: risky market participation decision, depth of risky asset allocation, and portfolio effectiveness. The impact of population aging on household financial asset allocation under the age dimension is studied. At the same time, financial knowledge, investment experience, and digital divide are utilized to construct information efficiency indicators that measure residents' information acquisition ability and information processing ability. Explore the information efficiency mechanism of aging affecting household financial asset allocation. Considering that there are differences in the degree of aging among households with different wealth and urban/rural natures, this article constructs an analysis of the heterogeneity of wealth and urban/rural natures to further illustrate the regional characteristics and urban/rural differences in the impact of aging on household finance in China.

3. Data and Methodology

3.1 Modeling

This study uses the Sharpe ratio, a portfolio effectiveness indicator, to measure the effectiveness of households' risky financial asset allocation. And the holding shares as well as Sharpe ratios can be observed only when households participate in risky financial markets4. At this time, the dependent variable is truncated data, so this study adopts a regression model with truncated data, the Tobit model, for estimating the impact of population aging on household allocation effectiveness. The specific functional form is as follows:

$$Sharp^{*}_{i,t} = \alpha_0 + \alpha_1 \text{head\_age}_{i,t} + \alpha_2 X_{i,t} + Year + Prov + \varepsilon_{i,t} \quad (1)$$

$$\text{Sharp}_{i,t} = max\left(0, \text{Sharp}^{*}_{i,t}\right) \quad (2)$$

$\text{Sharp}_{i,t}$denoting the Sharpe ratio.$\text{Sharp}^{*}_{i,t}$denotes the latent variable for the household i variable, controlling for province and time. $X_{i,t}$is the control variable; Year is the time fixed effect; Prov is the province fixed effect; $\varepsilon_{i,t}$is the random disturbance term.i denotes household, t denotes survey year; $\alpha_0$denotes a constant term, α_1 is the estimated coefficient on the independent variable, α_2 is the estimated coefficient on the control variable.

In order to investigate whether aging affects the behavior of household financial asset allocation by influencing changing the wealth level and health risk of households. This study adopts the mediation effect model to explore the wealth effect of aging on household financial asset allocation. Referring to the approach of JiangTing (Jiang, T., 2022), this study only verifies the effect of aging on the level of household wealth and health risk, as well as verifies whether aging affects the level of household wealth by changing the two paths of human capital investment and housing capital investment; and whether it affects the health risk faced by households by changing the health status of the household and health care expenditures. The specific functional form is as follows:

$$M_{i,t} = \alpha_0 + \alpha_1 \text{age}_{i,t} + \alpha_2 X_{i,t} + Year + Prov + \varepsilon_{i,t} \quad (3)$$

The explanatory variable M is $Edu\_con_{i,t}$、$Res\_con_{i,t}$ $\text{unhealth\_rate}_{i,t}$、$\text{M\_cost}_{i,t}$,denote household education expenditures, housing expenditures, percentage of non-healthy persons in the household, and medical expenditures, respectively. The other meanings in the formula are consistent with the above formula.

3.2 Data Sources and Processing

The data used in this paper come from the China Household Finance Survey (CHFS) conducted by the China Household Finance Survey and Research Center of Southwestern University of Finance and Economics. In this paper, the 2015-2019 data from the publishable data are selected as the raw micro household finance data. In addition, economic data involving Sharpe ratio accounting are obtained from the CSMAR database. The raw data preprocessing in this article includes: (1) excluding samples with negative household income and net worth; (2) excluding samples with abnormal and extreme data points for each variable to ensure the completeness and continuity of the sample. (3) Considering that the questionnaire defines the main economic source of the family as the head of the household, and the head of the household is mostly the family investment decision maker, only the sample of the head of the household who is 18 years old and above is retained for the study. (4) Construct a three-period financial survey tracking panel for 2015, 2017, and 2019. A total of 22,782 observations were finally obtained, and the empirical analyses were all done using Stata 17.0 software.

3.3 Variable Selection and Description

3.3.1 Explained Variables

Portfolio effectiveness (Sharp): the purpose of household financial asset allocation is to maximize utility, that is, the asset allocation is effective. Drawing on the calculation methods of Pelizzon and Weber and Wu et al (Gui, W., Chen, D., & Dong, W., 2022), the Sharpe ratio is used as a measure of the effectiveness of the household financial asset portfolio, and the Sharpe ratio measurement refers to the measurement method of Wu Yu et al. (Wu, Y., Li, X., Li, J., & Zhou, L., 2021). The method of index substitution is used to reflect the rate of return and risk of the household's various assets. The calculation formula is as follows:

$$\text{Sharp} = \frac{E(R_P)-R_f}{\sigma_P} \tag{4}$$

$E(R_P)$ Represents the expected annualized rate of return on the investment portfolio; R_f Represents annualized risk-free rate; σ_P Represents the standard deviation of the portfolio's annualized rate of return. Sharp denotes the Sharpe ratio of the household portfolio, i.e., the excess return per unit of risk, the higher the value, the more efficient the portfolio of household financial assets is as well, and the more efficient the household allocation of financial assets.

3.3.2 Explanatory Variables

In this paper, the age of the head of the household is used as a proxy indicator for the aging characteristics of the household. Age of the head of the household: The head of the household is defined by the CHFS questionnaire as “the main bearer of the economic resources of the household or the head of the household”, and is measured as the difference between the respondent's year of birth and the number of years of surveyed experience in the questionnaire.

3.3.3 Mechanism Variables

For wealth level, available funds, education expenditure, and housing expenditure were used as mediating variables. For health risk, family health and medical expenditures were used as mediating variables.

4. Control Variables

Referring to the existing studies, this paper divides the control variables into personal characteristics and household characteristics. The level of personal characteristics includes: marital status, gender of the head of household, education level, health status, risk attitude, and employment status. Household characteristics include: household income, household net worth, urban/rural residence, home ownership, and province of the household. A dummy proxy variable for the province where the household is located is also included. The variables are tabulated in the following table:

Table 1. Variable table

Variables	Symbols	Definition
Portfolio Effectiveness	Sharp	Ratio of Household Portfolio
Head of Household Age	Head_age	Age of the main decision maker (head of the household)
Head of Household Marriage	marriage	Married, remarried, cohabiting takes the value of 1, unmarried, divorced or widowed takes the value of 0.
Gender	Gender	Male=1; Female=0
Educational attainment	Edu	1-9, quantitative variable, the larger the value, the higher the educational attainment
Health	Health	When the physical condition of the residents is in very good, good when assigned a value of 1, otherwise 0
Employment	Job	Job head of household is employed=1, not employed=0
Risk_attitude	risk_attitude	is a quantitative variable with values 1-5, the larger the value, the smaller the risk preference.
household_income	income	The logarithm of the household income level
net_assets	net_assets	is the difference between total assets and total liabilities, logarithmic.
Urban/rural variable	rural	Whether the household lives in a rural area, 1 means rural, 0 means urban;
Whether the household owns its own home	Ifhou	owns takes the value of 1, otherwise it takes the value of 0
Province of the household	prov	Dummy variable for province of each location
Funds available to the family	A_funds	Logarithm of the sum of cash, demand deposits, third-party payment account balances, and stock account cash balances, plus one.
Human capital investment	Edu_con	Logarithmic of the level of household expenditure on education
Housing inputs	Res_con	Logarithm of household consumption expenditures on housing rent, housing maintenance, utilities, property, etc.
Family health status	unhealth_rate	Household self-assessed unhealthy population share
Medical expenditures	M_cost	Household health care expenditure in logarithmic terms

5. Analysis and Results

5.1 Baseline Regression Analysis

To investigate the impact of demographic changes in the age dimension on the effectiveness of household asset allocation under the aging shock. This study constructs the age of the household head as a characteristic proxy variable for aging and uses the Sharpe ratio as a proxy variable to measure the effectiveness of household portfolios. Afterwards, the proportion of aged population is used as a replacement variable, and the Probit model is used to replace the Tobit model as a robust type test. The results of the study are presented in Table 2. Column (1) of Table 2 shows that the reported regression coefficient of age of household head on Sharpe ratio is significantly negative at 1% level. It indicates that as the age of the head of household, who is the main investor of the household, increases, it reduces the household portfolio effectiveness. And each unit increase in age decreases household portfolio effectiveness by 2.23%.

To further validate the life cycle effect of population aging on household portfolio effectiveness, this study adds the squared term of age to the regression for illustration. Column (2) shows that the squared term of age is not significant, indicating that the effect of age on household portfolio effectiveness does not exhibit an inverted U-shaped or U-shaped relationship. Columns (3)-(4) of Table 2 show the results of the robustness tests for the replacement model, and the replacement variables, respectively. The age variable in the Probit model, as well as

the percentage of elderly population variable after the replacement variable are all significantly negative at the 1% level. It shows that population aging significantly suppresses household portfolio effectiveness; and this conclusion still holds after the robustness test of the replacement variables and the model.

Table 2. Benchmark regression results and robust-type tests

	Tobit	Tobit	Probit	Tobit
VARIABLES	(1) sharp	(2) sharp	(3) sharp	(4) sharp
head_age	-0.0223***	-0.0223***	-0.0080***	
	(0.0025)	(0.0025)	(0.0012)	
c_age_square		0.0000	-0.0000	
		(0.0001)	(0.0001)	
older_rate				-0.6352***
				(0.0791)
Control	Y	Y	Y	Y
Year	Y	Y	Y	Y
Province	Y	Y	Y	Y
Pseudo R2	0.1683	0.1683	22,782	0.1676
Observations	22,782	22,782	0.2836	22,782

5.2 Mechanism Analysis

With the trend of population ageing, family decisions such as childbearing and homeownership affect the allocation of financial assets by changing the level of funds available to the family. On the one hand, population ageing is accompanied by a delay in childbearing, and decisions about childbearing increase family education expenditures and reduce the level of funds available to the family. On the other hand, aging populations lead to smaller household sizes, an increase in the proportion of empty nesters, and a decrease in housing expenditures for older households, thereby freeing up capital. In order to further verify whether population aging affects the effectiveness of household financial asset allocation by changing the level of available funds, this study therefore constructs available funds, education expenditures, and housing expenditures to measure household available funds. The regression results are shown in columns (1)-(3) of Table 3, which show that the regression coefficients of age on available funds are significantly positive at the 1% level; and the regression coefficients of education expenditures and housing expenditures are all significantly negative at the 1% level. This indicates that as age increases, household education and housing expenditures will decrease thus releasing funds and the level of household available funds will increase. In the category of factors influencing the allocation of household financial assets, some scholars have studied the impact of wealth status indicators such as household income, net worth, and housing assets on the allocation of household financial assets. The studies generally agree that a higher level of wealth promotes household investment in risky financial assets. As a measure of wealth level, higher household available capital means that households have more funds to allocate to risky financial assets, have a greater possibility of participating in risky financial markets, and obtain higher returns. It is verified that population ageing affects the effectiveness of household monetary asset allocation by changing the level of household available funds.

To further verify whether population aging inhibits the allocation of household financial assets by increasing household health risk, this study therefore constructs the household health situation, medical expenditure variable for measuring household health risk. The regression results are shown in Table 3. The results in columns (4)-(5) of Table 3 show that the regression coefficients of age on household health situation and medical expenditures are significantly positive at the 1% level; this illustrates that the proportion of non-healthy people in the household and medical expenditures will increase with age, and the household will be exposed to higher health risks. Existing studies point out that health risk as a background risk directly affects the risk exposure faced by households, which in turn affects household investment decisions. It is verified that population ageing discourages households from participating in risky financial markets and reduces their risky financial asset holdings and portfolio effectiveness by increasing household health risks.

Table 3. Mechanisms by which population aging affects portfolio effectiveness

	(1)	(2)	(3)	(4)	(5)
VARIABLES	A_funds	Edu_con	Res_con	unhealth_rate	M_cost
head_age	0.0067***	-0.1066***	-0.0100***	0.0046***	0.0211***
	(0.0016)	(0.0024)	(0.0007)	(0.0002)	(0.0019)
Control	Y	Y	Y	Y	Control
Year	Y	Y	Y	Y	Year
Province	Y	Y	Y	Y	Y
Observations	22,782	22,782	22,782	22,782	22,782
R-squared	0.2875	0.1743	0.2435	0.1181	0.0838

5.3 Heterogeneity Analysis

Owing to the obvious differences between the economic and social development of urban and rural areas in China, the negative impact of population ageing on the allocation of financial assets of urban and rural families is quite different. Compared with rural households, urban households have better medical resources and living conditions, as well as more institutions and facilities for the elderly. Older people in urban households live longer on average, demonstrating that the degree of aging is generally higher in cities than in rural areas. However, because rural families rely more on the traditional family approach to old-age care, which relies more on child support, the old-age care function of rural families has weakened with the exodus of the younger population, and the old-age care problem posed by an ageing population has become more acute. As a result, rural households tend to have a relatively single economic source, more prominent health risk problems, weaker risk resistance, and a stronger negative effect on household financial asset allocation. This study constructs urban-rural dummy variables to join the regression to further analyze the urban-rural heterogeneity of population aging affecting the allocation of household financial assets, and uses the seemingly uncorrelated model SUR test to test the difference in coefficients between groups. The regression results are shown in columns (1)-(2) of Table 4, which indicate that age of the head of household in both urban and rural households can have a significant negative impact on portfolio effectiveness. The regression coefficient of age is -0.0195 for urban households and -0.0464 for rural households. Comparison shows that the age of the head of the household in urban households has less inhibitory effect on the Sharpe ratio. This indicates that the negative effect of population aging on the effectiveness of household financial asset allocation is more significant in rural households.

The level of residential wealth often has a direct impact on the ability of households to consume, and households with higher levels of wealth are more likely to participate in risky financial markets, hold more risky financial assets and earn higher returns. In this study, different wealth subgroups are divided according to the median net worth, and households with net worth below the median are defined as the low wealth group. Dummy variables for wealth level are constructed and added to the regression to further analyze the wealth heterogeneity of financial asset allocation of households affected by population aging, and the SUR test of the seemingly uncorrelated model is used to test the difference in coefficients between groups. The regression results are shown in columns (3) -(4) of Table 4, and the results show that age of the head of the household has a significant negative impact on portfolio effectiveness in both low wealth level households and high wealth level households. The regression coefficient of age is -0.0434 for low wealth level households and -0.0187 for high wealth level households. The comparison shows that age has less inhibitory effect on the Sharpe ratio in households with higher wealth level. This suggests that the negative impact of population aging on household financial asset allocation is more significant in households with low wealth levels.

Table 4. Analysis of urban-rural and wealth heterogeneity

	(1)	(2)	(3)	(4)
	City	Rural	Low-wealth	High-wealth
VARIABLES	sharp	sharp	sharp	sharp
head_age	-0.0195***	-0.0464***	-0.0434***	-0.0187***
	(0.0025)	(0.0103)	(0.0084)	(0.0026)
Control	Y	Y	Y	Y
Year	Y	Y	Y	Y
Province	Y	Y	Y	Y
Pseudo R2	0.1310	0.1429	0.1264	0.0050
Observations	14,420	8,362	11,369	11,413
p-value	0.0115**		0.0050***	

6. Conclusion

This paper constructs cross-period panel data based on the 2015-2019 China Household Finance Survey (CHFS) data, and uses a combination of comparative, theoretical, and empirical analyses to study the effectiveness of population aging in affecting household financial asset allocation through wealth constraints and health risk pathways. The moderating role played by the level of comprehensive information efficiency in the process is also illustrated. The main conclusions are as follows.

First, under the age dimension, population aging has a significant inhibitory effect on portfolio effectiveness. And the effect of age on portfolio effectiveness has not yet shown inverted U-shaped as well as U-shaped characteristics.

Second, the mechanism analysis illustrates that population aging affects portfolio effectiveness through wealth constraint, health risk, and information efficiency paths. In general, population aging releases funds through lower education and healthcare expenditures and reduces household wealth constraints. However, population aging will be accompanied by an increase in health risk, which is manifested by a deterioration in overall household health and an increase in healthcare expenditures.

Third, the heterogeneity analysis illustrates that there is urban-rural and wealth heterogeneity in the impact of population aging on financial asset allocation. The negative impact of population aging on the effectiveness of household financial asset allocation is more pronounced in rural households and more significant for low wealth level households. On the one hand, rural-level households rely more on the traditional family pension method of child support, and with the exodus of the young population, the pension problem posed by population aging is more severe. On the other hand, rural households tend to have a relatively single source of income, with more prominent health risk issues and weaker risk tolerance.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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